

DOCUMENT RESUME

ED 040 097

95

SO 000 026

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TITLE Egocentrism and Map Reading Ability.
INSTITUTION American Educational Research Association,
Washington, D.C.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau
of Research.
PUB DATE Mar 70
GRANT OEG-5-9-245130-0013
NOTE 16p.; Presented at the American Educational Research
Association Convention, Minneapolis, Minnesota,
March 1970

EDRS PRICE MF-\$0.25 HC-\$0.90
DESCRIPTORS Cognitive Ability, Cognitive Development, *Concept
Formation, *Elementary School Students, Intelligence
Factors, Learning Readiness, *Map Skills,
Measurement Techniques, *Perceptual Development,
Research Methodology, *Social Studies, Space
Orientation

IDENTIFIERS *Egocentrism, Piaget, Test Coordination Perspectives

ABSTRACT

Egocentrism was investigated as an influencing factor in the development of the perceptual abilities needed to understand and interpret topographic maps. Attainment of an adequate concept of space, and the ability to accurately perceive spatial relationships (perspectives) are considered fundamental. Piaget and Inhelder identified three stages of conceptual development (age 4-6, no conceptualization of space; age 6-8, a child is bound by egocentrism, but understanding of spatial relativity has begun; age 7-12, evidences progressive discrimination and coordination of perspectives). The basic objective of this study was to test these generalizations with American elementary children, hypothesizing that there is a sequential pattern to conceptual development, but, that these three stages would occur earlier in today's society. A test was designed to replicate and extend Piaget's. The relationships between perceptual abilities and each of these factors: chronological age, intelligence, socio-economic status, knowledge of left-right relationships were tested and found to be statistically significant. There was a definite negative correlation between the degree of egocentrism and the ability to understand and interpret maps. Overall, Piaget's developmental sequence was substantiated with the stages occurring at only slightly earlier ages. (SBE)

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ED0 40097

Egocentrism and Map Reading Ability

A Paper Presented
to the American Educational
Research Association
Minneapolis, 1970

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SO 000 026

Egocentrism and Map Reading Ability*

Introduction

One of the problems which continues to plague those involved with geographic education is that of when, how and what to teach about maps. To be sure, there are a number of map "programs" in use in the schools, but few if any have been based on research evidence which might support the efficacy of the program. Indeed, much of what is presently available is a result of some suppositions as to what may or may not work with some students, limited successes with isolated cases, and a loose sequence of techniques based on random observations, questionable logic and the tradition of what we have been doing for years.

The mass confusion surrounding this area of the curriculum is apparent even if one is to consider the rudimentary question of when to begin instruction in mapping. The lack of consensus is appalling. Some "experts" claim that these skills ought to be taught to children at the kindergarten level. While at the same time, other are adamant in their arguments that map reading should not and indeed cannot be taught before the fourth grade level. Hence, when considering even the age at which to begin instruction, we find arguments for starting anywhere within a four year spread from ages five to nine.

Turning to a consideration of what to teach and the sequence in which it ought to be taught, one finds a similar quagmire of conflicting opinions. Some say that topics such as topographic map interpretation cannot be taught and should not even be attempted before the high school level, if then. At the same time, enterprising teachers counteract this with examples of how they have already taught their grade three class to read

* This study was supported by a USOE grant No. OEG-5-9-245130-0013-(010).

topographic maps! The controversy continues and while we may be coming more and more to an acceptance of the Brunerian hypothesis that we can teach some aspects of even the most sophisticated map skills at practically any age level, the problem still remains - we don't know what to teach, when to teach it or how to teach it.

Much of this problem lies in the fact that we are ignorant of exactly what is involved in the child's attainment of mapping skills. That is, we have not as yet been able to determine what cognitive processes a child must be capable of before he may comprehend a map. At the same time, we have not been very successful in devising measures which might enable us to assess the degree of cognitive competence a child does possess and finally, we have not tackled the problem of how to teach specific map skills even if we knew what mental abilities were prerequisites and what level of development our students had achieved at any given time.

Egocentrism, Perception and Maps

One of the most promising areas of study in connection with the problem of teaching maps involves the notion of perception. Numerous studies such as those by Pedde (1966), Satterly (1964), Towler (1965) have indicated that the attainment of an adequate concept of space and the concomitant accuracy of spatial perceptions are fundamental to a child's ability to understand a map. In other words, it is unreasonable to expect a child to understand any symbolic representation of the real world until he has developed accurate concepts of that world.

For example consider the six skills which Kohn (1953) suggests are necessary to map reading and interpretation:

1. Ability to orient the map and note directions.
2. Ability to recognize the scale of a map and compute distance.
3. Ability to locate places on a map - by means of a grid system.

4. Ability to express relative locations.
5. Ability to read map symbols.
6. Ability to compare maps and make inferences.

Each and every one of these skills is based on the assumption that the child has an adequately developed concept of the real world and that he can accurately perceive the spatial relationships involved. However, current research into the spatial abilities of children indicate that their concept of space is grossly inaccurate when they are young and that their ability to develop accurate concepts is something that takes place over a period of years lasting well into school age.

One of the spatial concepts most relevant to map skills is that of egocentrism or the cognitive state in which the world is perceived from a single viewpoint, there being no differentiation between one's own perspective and that of others. This phenomena occurs in both a concrete and an abstract sense. That is, it has been established that young children do not realize that someone else viewing a set of objects from another location, may see a different viewpoint or perspective. Such children are also unable to adopt a point of view different from their own even in a discussion. In other words, a young child cannot put himself "in the shoes" of another person and see things from his point of view either figuratively or literally.

It stands to reason then, that children who are egocentric in their perceptions of the real world must have great difficulty in perceiving that world as it is represented on a map. Consequently, such children would experience trouble in their attempts to read and understand maps. This reasoning coupled with the fact that egocentrism may be identified in children as old as 11 or 12 years of age, could serve to explain why children have difficulty with map interpretation. Furthermore, if we could establish the pattern of development in which the child moves to a non-egocentric concept of space, then we would be in a position to plan

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more adequately both the time at which certain map skills might profitably be taught and the kind of map skill which might fit in with the child's level of mental development.

Previous Studies

One of the first studies of egocentrism and spatial perceptions was conducted by Piaget and Inhelder (1963) over 20 years ago in Switzerland. In the interim, very few studies have attempted either to replicate or extend their findings with respect to American children. In the original experiment, Piaget and Inhelder tested a sample of 100 children about whom very little is known other than the fact that they ranged in age from 4 to 12 years. The experiment consisted of three types of tasks involving a three dimensional model of three mountains which differed in size, shape, and color.

As a result of their investigations, the authors identified three stages of conceptual development. However, the ages at which these stages occur are not stated explicitly and must be extrapolated from the data. The following age-at-age relationships were identified:

Stage I. (4-5 or 6 years). A child at this stages does not understand the questions and consequently cannot participate in the experiment.

Stage II. (6 to 7 or 8 years). Throughout this stage, the child has great difficulty distinguishing between his viewpoint and that of other observers.

At substage IIA, the child is bound by a egocentric illusion in which he fails to realize that any viewpoint other than his own is possible.

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In substage IIB, the child shows some attempt at discrimination but lapses back into the egocentric constructions of substage IIA. However, Piaget and Inhelder identify substage IIB as the beginning of a transition between spatial egocentrism and an understanding of true relativity which appears later.

The child at stage II has not developed an understanding of before-behind or left-right relationships and therefore cannot master a task requiring a coordination of perspectives.

Stage III. (7-8 to 11-12 years). The child at this stage evidences a progressive discrimination and coordination of perspectives. At substage IIIA (7-8 to 9 years), he has discovered the before-behind and left-right relationships but cannot combine these into a comprehensive coordination of perspectives. That is, the child can take one of these relationships into account, but cannot use both types simultaneously.

The final substage, IIIB (9-10 years) is characterized by the complete mastery of perspective in which the correspondence between the observer's position and the projective relationship is understood by the child. The investigators found that the children at level IIIB found it easier to replicate the scene with the three cardboard cut-outs than to choose the correct picture of the model. This is an interesting finding as it seems to support Piaget's theory that children learn best through manipulative type actions.

Piaget and Inhelder explain their findings by hypothesizing that a system of projective relationships or perspective viewpoints consists of mental operations which assemble perceptual data and coordinate it in terms of reciprocal relationships. In addition, they state that the development of a perspective system is dependent upon acts of intelligence and is, therefore, conceptual rather than merely perceptual in character.

One of the few American studies dealing specifically with this topic was conducted by Miller (1967). This study involved 150 children from kindergarten to 6th grade. However, the test items concerned a three-dimensional fictitious island group rather than mountains and the questioning techniques also differed from those of Piaget and Inhelder. In general, Miller found a sequential pattern in the development of perceptual ability, but his report does not attempt to compare his findings with the age-stage relationships of Piaget and Inhelder.

Rationale

One of the prime concerns of this study was to investigate egocentrism and the development of children's abilities to coordinate perspectives. As previously noted, Piaget and Inhelder's study is now 20 years old and generalizations to American children generally are still relatively untested. In addition, it was neither tightly controlled nor were any attempts made to rigorously analyze the data. If their general method is to be applied to a study of children in this society, their techniques and procedures must be refined. Specific areas for improvement are as follows:

1. Piaget and Inhelder used a model of three mountains which, one would assume, would be familiar to the Swiss children involved in the study. However, if familiarity of the landscape is to be retained as a factor, then one ought not to present urban children with a less familiar rural or island landscape.
2. Piaget and Inhelder's first questioning technique required the children to reproduce certain perspectives with the aide of two dimensional cardboard cut-outs. However, Pedde (1966) has found that young children have great difficulty in moving from a three dimensional model to a two-dimensional representation of it. Yet this was the requirement set by the Geneva investigators and upon which they based much of their age-staged relationships.

3. There has been no attempt to determine the relationship between socio-economic status and the development of the ability to coordinate perspectives despite the evidence suggesting that this may be an important factor. Consequently, this parameter was also under investigation.

Research Hypotheses

1. There is a sequential pattern in the development of children's abilities to coordinate perspectives.
2. The use of an urban environment in the Test of Coordination of Perspectives will result in an earlier development of the age-stage relationships than found by Piaget and Inhelder.

The following hypotheses were tested statistically.

1. There is a significant correlation between chronological age and the ability to coordinate perspectives.
2. There is a significant correlation between intelligence and the ability to coordinate perspectives.
3. There is significant correlation between socio-economic status and the ability to coordinate perspectives.
4. There is a significant correlation between a knowledge of left-right relationships and the ability to coordinate perspectives.
5. There is a significant difference in the mean scores of the high and low socio-economic groups on the Test of Coordination of Perspectives when the effect of intelligence is removed.
6. There is a significant difference between the mean scores on the Test of Coordination of Perspectives for subjects living in urban as opposed to rural environments.

The Sample

A stratified random sample was drawn from the elementary school populations of Tippecanoe County and West Lafayette, Indiana. The stratification criteria were English as the native language, absence of defective visual problems and high and low socio-economic status as measured by the Hollingshead Two-Factor index. On the basis of the above, 140 subjects were chosen, 10 per grade level K through 6, for each school system. The age ranges were from 5.0 to 12.7 years and the mean IQ was 110.4 as measured by the Lorge-Thorndike IQ test.

The Instruments

A Test of Coordination of Perspectives (TCP) designed by the investigator was administered individually to each subject. This test consists of three subtests following the pattern established by Piaget. Each subtest was designed to replicate and extend Piaget's tests of perceptual ability.

The testing materials consist of two three-dimensional plastic models of an urban environment of buildings and streets on circular bases, a doll and eight color photographs of one of the models.

In subtest I, the subject was shown one of the models. The doll was placed in one of eight positions around the base of the model and the subject was asked to reconstruct the doll's perspective using the apparatus of model 2.

Subtest II - The subject was shown photographs of the first model taken from various perspectives and was asked to identify the one most suited to the view of the doll which the examiner had placed on the model.

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Subtest III. The subject was given one of the eight photographs and asked to place the doll on the model where it would have to be to "see" this view.

The subjects' knowledge of left-right relationships was assessed by means of an instrument derived from one first used by Piaget (1928) and adapted by Elkind (1961). A need for further refinements was apparent as a result of the pilot study preceeding this investigation,

Discussion of the Findings

The Hypotheses

The results of the study in terms of the hypotheses were as follows:

Hypothesis 1. There is a significant correlation between chronological age and the ability to coordinate perspectives. This hypothesis was accepted for each subtest of the TCP and the total TCP score.

Hypothesis 2. There is a significant correlation between intelligence and the ability to coordinate perspectives. This hypothesis was also accepted for each of the subtests and the total TCP score.

Hypothesis 3. There is a significant correlation between socio-economic status and the ability to coordinate perspectives. Statistically, there was a significant correlation (.01 level) and the hypothesis was accepted, however, when viewed together with the results of hypothesis 5 which found that differences between high and low socio-economic groups disappeared when the effects of intelligence was considered, the validity of this hypothesis must be reassessed. Nevertheless, there is reason to believe that socio-economic status factors and/or the subjects environments did have an effect on their ability to perform on the TCP.

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Hypothesis 4. There is a significant correlation between a knowledge of left right relationships and the ability to coordinate perspectives. This hypothesis was accepted. In addition, it was apparent from the observations of the examiners and from Piaget's theory, that the subjects' awareness of and facility in applying before-behind relationships to TCP task items also led to an increase in ability to coordinate perspectives.

Hypothesis 5. There is a significant difference in the mean scores of high and low socio-economic status groups on the TCP when the effect of intelligence is removed. This hypothesis was rejected. It is at this point, however, that a number of factors are called into question, namely the relationships among socio-economic status, intelligence, urban or rural environments and the ability to coordinate perspectives. It would seem from these results, that the difference in the performance of the subjects at the two schools could be attributed to the effects of intelligence, however, in the one grade level when the IQ scores were most similar, (grade one, means of 101.8 in School A, 102.1, School B) the differences between the subjects' scores still appears.

These results are not attributable to intelligence alone, but there is no way to determine which if either of the other factors mentioned, above is responsible. It does, nevertheless, tend to support the investigators hypothesis that these factors do have an effect on the acquisition of the concepts under investigation.

Even if one wished to dismiss the data from the first grade subjects as isolated and irrelevant, there is still the problem of why the subjects from the urban, higher socio-economic status area performed at a higher level on the intelligence tests and the TCP. That is, what are the common elements being measured by these instruments and what is it in the environment of these children which permits them to achieve higher scores on these two tests?

Hypothesis 6. There is a significant difference in the mean scores on the TCP for subjects living in urban as opposed to rural environments. This hypothesis was also rejected, since while a difference did appear, it was nullified when the effect of intelligence was taken into consideration.

The Working Hypothesis. Two other hypothesis were proposed in this study. The first hypothesis stated that there would be a sequential pattern in the development of childrens' abilities to coordinate perspectives. This hypothesis was accepted since a pattern of stages was established for the sample as a whole. The second hypothesis stated that the use of an urban environment in the TCP instrument would result in an earlier development of the age-stage relationships than found by Piaget. This hypothesis was rejected, but with reservations since while there was an earlier development in the case of the urban sample, it may have been attributable to their higher intelligence.

The Age-Stage Relationships

In comparing the age-stage relationships found in this sample with those reported by Piaget, the following points were noted:

The developmental sequence initially identified by Piaget seems to apply to this sample. That is, there are three separate stages in the pattern of development and each one is characterized by a distinctive type of response ranging from egocentrism to an awareness of left-right or before-behind relationships, then the ability to coordinate these relations and finally the correct coordination of perspectives.

With regard to the ages at which these stages appear, however, the results of this study differ from Piaget's in several aspects. First, Piaget claims that children within the age range of 4 to 5 or 6 years cannot participate in the experiment due to their inability to understand the questions and to respond to the test. This was not the case with this

sample. Children as young as 5 years were tested and found to be not only capable of understanding the questions and performing on the tests, but in some cases, even the youngest achieved a surprising degree of accuracy. Thus it would appear that either the experimental materials and procedures used in this study are more readily understood than Piaget's or that young children in this sample are more advanced than those in Piaget's sample. Since the tests were designed after those used by Piaget and may be considered to be replicates of his, the first explanation does not seem applicable, particularly since some of the youngest subjects not only understood the tests, but performed well on them.

The second discrepancy concerns the ages at which the stages of development occurred for this sample. As has already been pointed out, the subjects from School B progressed through the same stages and at the same ages as Piaget reports, while the subjects from School A appeared to have developed these stages approximately one year earlier. This difference in development may be caused by the difference in the intelligence scores of the two groups of subjects, however, it should be noted that the mean IQs of both groups fall within the normal range as measured by the Lorge-Thorndike instrument. The Lorge-Thorndike test renders a norm of 100 and a standard deviation of 16. The mean IQ for the urban group was 115.28 and the rural group had a mean IQ of 104.58. Consequently, it may be stated that within a normal IQ range, some children are as much as one year in advance of Piaget's age-stage relationships.

Knowledge of Left-Right Relationships

While the investigator has some reservations concerning the validity and reliability of the instrument used to assess this factor, it is readily apparent that it was a key element in the development of the ability to coordinate perspectives. In addition, it would seem that children do not develop a very high ability to use left-right relationships until the fourth or fifth grade and that this is closely linked to intelligence and chronological age.

Implications

Psychological Aspects

It would appear that from these results that children are not as egocentric as Piaget found with his study several years ago. Not only are young children more capable of attempting to coordinate perspectives than he suggests, but even the youngest subjects do not give completely egocentric responses. This data agrees with that of Shantz and Watson (1967) who found that contrary to Piaget's findings, some very young children do have gross expectations concerning the relationships between objects and their orientations. However, it is apparent that children do have imperfect conceptions regarding perspectives other than their own and that the ability to coordinate perspectives accurately does not appear until the age of ten or eleven.

It seems clear that the development of this ability is dependent upon growth in intelligence and chronological age. In addition, there is reason to believe that such factors as socio-economic status and environment may have an effect on the ability. In any event, progression from egocentrism to an accurate coordination of perspectives does follow a sequential pattern which requires the child to take a series of mental operations into consideration simultaneously and to utilize these relations as an operating system of references.

The problem of differentiating the effect of intelligence, environment and socio-economic status continues to be perplexing. This study did reveal a difference in the age-stage relationships for two groups of subjects of different backgrounds and environments. Studies of egocentrism and map reading ability by other researchers have resulted in findings which lead to the hypothesis that socio-economic and environmental differences may be the most significant variables. For example, Lesser, et. al. (1965) found that in regards to spatial conceptualization, social class differences result in significant differences in the absolute level of develop-

ment but not in the pattern of development. This is similar to the situation reported here with regard to the development of egocentrism. Similarly Neale (1966) found that differences in home backgrounds were related to differences in the degree of egocentrism. Further evidence is provided in a study by Feldman (1969) who discovered that differences in ethnic backgrounds resulted in differences in tests of spatial reasoning and map drawing.

Implications for the Teaching of Maps and Mapping

It is obvious that there is a direct relationship between degree of egocentrism and the child's ability to develop accurate perceptions about his world. It follows that the more egocentric a child is, the more difficult it must be for him to understand maps and mapping. Unfortunately, the factors underlying egocentrism and the factors influencing the child's development of a non-egocentric point of view are poorly understood. Nevertheless, if we are to build map reading programs suited to the psychological readiness of the child, we must take his level of egocentrism into account. In order to do this, we need further research into the problem: research that is directed specifically to accomplish the following:

- develop a valid and reliable test of egocentrism,
- determine the exact relationship between egocentrism and map reading ability,
- discover the nature of the mental operations which lead a child to non-egocentric point of view,
- develop a method of helping a child to become less egocentric at a very early age.

Until we can accomplish these ends, we will continue to plunge blindly along, attempting to teach map reading skills with an almost total disregard for the pupils' state of psychological readiness.

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